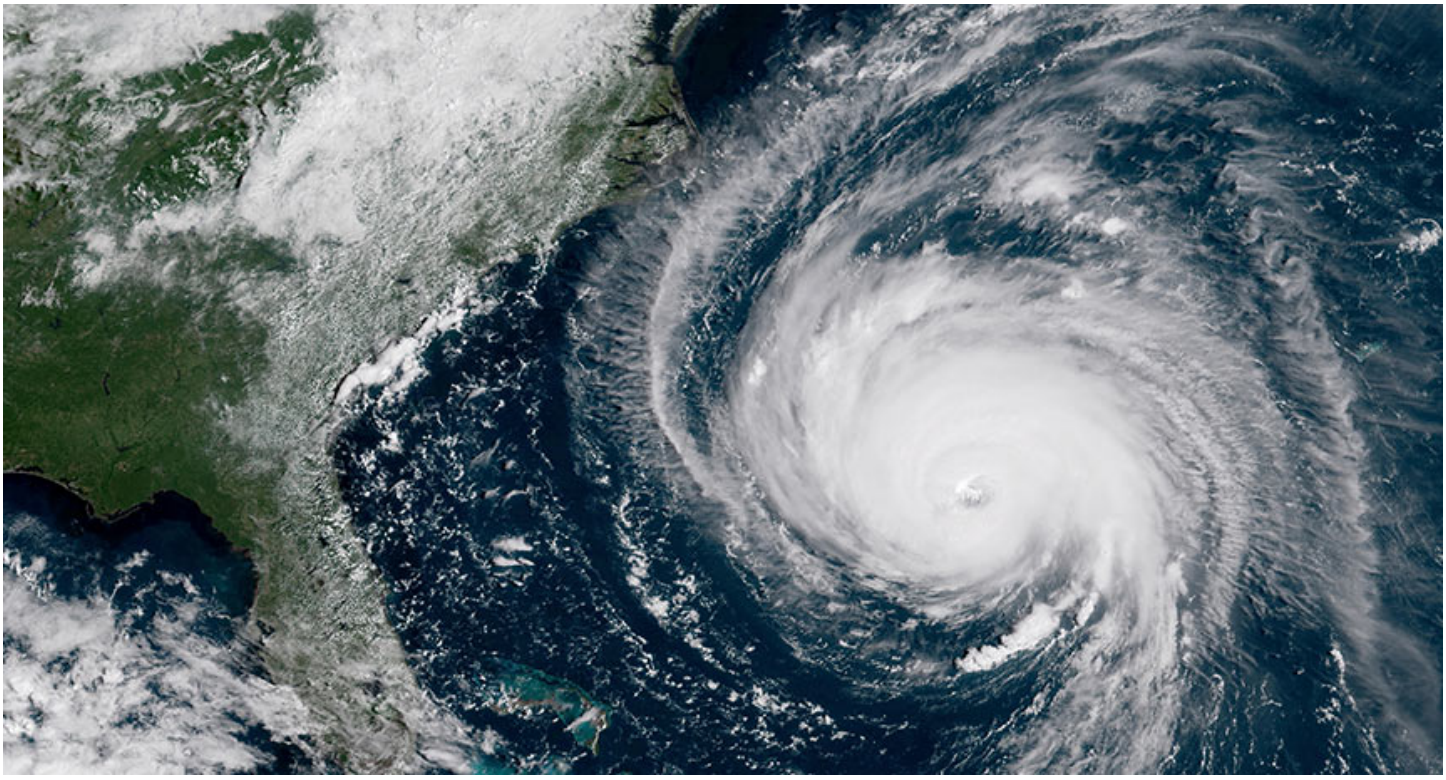
ScienceNews

IN HIGH SCHOOLS | EDUCATOR GUIDE



Stocktrek Images, Inc./Alamy

December 22, 2018 & January 5, 2019

2018 Year in Review

SOCIETY FOR SCIENCE & THE PUBLIC

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

About This Guide

Use this Guide to review the biggest science stories of 2018, as reported by *Science News* (*SN*). Topics covered include human-caused climate change, the controversial birth of the first gene-edited babies and newfound evidence for a lake on Mars.

This Guide includes:

Article-based observation, Q&A — Students will work in groups to analyze one of *SN*'s Top 10 science stories of 2018 and connect the article to a previously published *Science News* article. Summaries of each article are provided for the teacher.

> **Article-based observations, questions only —** These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular connections, Q&A — Students will define key vocabulary to gain some scientific background knowledge and to better understand the concepts covered in *SN*'s Top 10 science stories. Questions are divided by subject area (including Environmental Science, Biological Sciences, and Physics and Astronomy) and article. After defining the terms provided, students can discuss additional terms and concepts that might need further research or explanation.

> **Cross-curricular connections, questions only —** These questions are formatted so it's easy to print them out as a worksheet.

Activity: Asking for Directions on Mars

> **Purpose:** Students will learn how to use an interactive online map of Mars — including working with coordinate systems and layers — and will identify features and make generalizations about Martian geography.
>
> **Procedural overview:** After a review of latitude and longitude, students will explore NASA's Mars Map, first through a tutorial and then on their own. Students will identify specific sites and will use the map's interactive tools to learn more about the sites and locate nearby geographic features. Finally, students will make geographic generalizations about specific regions. Sites on Mars come from "A buried lake on Mars excited and baffled scientists," "A year of launches and farewells in space" and even from the fictional film *The Martian*.
>
> **Approximate class time:** One class period.

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Standards

Next Generation Science	Common Core ELA
Matter and its Interactions: HS-PS1-1, HS-PS1-3, HS-PS1-8	Reading Informational Text (RI): 1, 2, 4, 5, 7
Motion and Stability: Forces and Interactions: HS-PS2-1, HS-PS2-4, HS-PS2-5, HS-PS2-6	Writing (W): 1, 2, 3, 4, 6, 7, 8, 9
Energy: HS-PS3-1, HS-PS3-2, HS-PS3-5	Speaking and Listening (SL): 1, 2, 4, 5, 6
Waves and their Applications in Technologies for Information Transfer: HS-PS4-1, HS-PS4-4, HS-PS4-5	Reading for Literacy in Science and Technical Subjects (RST): 1, 2, 3, 4, 5, 7, 8, 9
From Molecules to Organisms: Structures and Processes: HS-LS1-1, HS-LS1-2, HS-LS1-4	Writing Literacy in History/Social Studies and Science and Technical Subjects (WHST): 1, 2, 4, 7, 8, 9
Ecosystems: Interactions, Energy and Dynamics: HS-LS2-6, HS-LS2-7, HS-LS2-8	
Heredity: Inheritance and Variation of Traits: HS-LS3-1, HS-LS3-2	
Biological Evolution: Unity and Diversity: HS-LS4-1, HS-LS4-2, HS-LS4-4, HS-LS4-5	
Earth's Place in the Universe: HS-ESS1-1, HS-ESS1-2, HS-ESS1-3, HS-ESS1-4, HS-ESS1-6	
Earth's Systems: HS-ESS2-2, HS-ESS2-4, HS-ESS2-5, HS-ESS2-7	
Earth and Human Activity: HS-ESS3-1, HS-ESS3-2, HS-ESS3-4, HS-ESS3-5	
Engineering Design: HS-ETS1-1, HS-ETS1-2, HS-ETS1-3	

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Article-Based Observation: Q&A

Directions: Divide your students into group, assigning each group one of the *SN* Top 10 articles. Ask students to answer questions No. 1 and 2 before they read (5 minutes). After allowing 20 minutes for silent reading, have students answer questions No. 3 through 6 (20 minutes). You can ask each group to share the results with the class.

2018 Year in Review: Top 10

1. "Half a degree stole the climate spotlight"
Readability score: 10.8
2. "Claim of first gene-edited babies sounded alarms"
Readability score: 10.2
3. "Crime solvers embraced genetic genealogy"
Readability score: 11.0
4. "Neutrino discovery ushered in a new era of astronomy"
Readability score: 12.8
5. "Crater renewed debate over an ancient climate mystery"
Readability score: 11.1
6. "We nudged closer to the Mosquito Terminator"
Readability score: 11.8
7. "Researchers sent mixed messages about drinking"
Readability score: 10.5
8. "A buried lake on Mars excited and baffled scientists"
Readability score: 9.0
9. "Paralysis became less permanent with electricity"
Readability score: 11.2
10. "Human smarts got a surprisingly early start"
Readability score: 13.6

1. Read the headline of the article. What background information do you already know about the topic based on the headline?

2. Given the headline, what do you want or expect to learn when you read the article?

3. Summarize what you learned from the article in 100 words or less.

Possible student responses:

Story 1. "Half a degree stole the climate spotlight"

A new report by the Intergovernmental Panel on Climate Change examined the predicted environmental impacts if the average global temperature rises by either 1.5 or 2.0 degrees Celsius above preindustrial levels by the year 2100. Though either scenario comes with dramatic consequences, holding to 1.5

degrees C would mean less sea level rise, fewer species lost to habitat degradation and fewer life-threatening heat, drought and precipitation extremes. The report notes that the planet's average temperature has already increased by nearly 1 degree C and that rise is contributing to extinctions, lower crop yields and more frequent wildfires.

Story 2. "Claim of first gene-edited babies sounded alarms"

A Chinese researcher, Jiankui He, claims to have produced the first gene-edited babies and says at least one more baby is on the way. He said he used the gene-editing tool CRISPR/Cas9 to disable the *CCR5* gene in fertilized eggs, with the goal of making the babies born from those eggs resistant to HIV infection. Other researchers are not convinced that the gene editing was successful or that it didn't damage other genes. The researchers note that disabling *CCR5* might increase susceptibility to serious complications from infections like West Nile.

Story 3. "Crime solvers embraced genetic genealogy"

In 2018, law enforcement arrested at least 18 suspects with the help of genetic genealogy searches. Investigators compared DNA profiles from crime scenes with DNA profiles from more than a million people who have voluntarily put their DNA data online to search for relatives. Even though the suspects did not upload their DNA profiles, relatives had, enabling investigators to identify the suspects by re-creating their family trees. This new type of DNA-based detective work has raised questions about genetic privacy and police procedures.

Story 4. "Neutrino discovery ushered in a new era of astronomy"

The IceCube neutrino observatory in Antarctica detected a high-energy neutrino from one region of space. Soon after, astronomers spotted a flare from a blazar about 4 billion light-years away in that same region. Old data yielded evidence of even more neutrinos from near the blazar's location in the sky, which helped convince some researchers that the blazar birthed neutrinos. With upgraded technology and more detections, neutrinos might be used to probe blazars and other potential sources, such as neutron star collisions.

Story 5. "Crater renewed debate over an ancient climate mystery"

NASA scientists have identified what appears to be a 31-kilometer-wide crater beneath Greenland's Hiawatha Glacier. Based on elements in glacial outwash, the discoverers think that an iron meteorite made the crater, which likely formed between 2.6 million and 11,700 years ago. Some scientists wonder if the impact could be responsible for an ancient cold snap that began 12,800 years ago and has been blamed for the extinction of the mammoths and the disappearance of a group of people known as the Clovis.

Story 6. "We nudged closer to the Mosquito Terminator"

Scientists at Imperial College London used a gene drive to exterminate two small lab populations of malaria-causing *Anopheles gambiae* mosquitoes. In lab tests, mosquitoes that were given a gene that made female mosquitoes unable to reproduce passed that gene to all of their offspring. The populations went extinct within a few generations. If that technique works in the wild, it could eliminate mosquitoes that carry certain diseases, but the tool is a long way from practical use and ethical concerns abound.

Story 7. "Researchers sent mixed messages about drinking"

In 2018, two studies contradicted evidence that an occasional drink might have health benefits. Both studies were meta-analyses, combining data from numerous observational studies that tracked what large numbers of people drank over time and compared rates of disease or death in those populations. In one study, people who had more than about seven drinks per week had a lower life expectancy and a higher risk of stroke, heart failure and other problems compared with light drinkers. The second study claimed that anything more than abstinence, or no drinks at all, is risky. Some researchers took issue with broad conclusions and noted problems with the design of meta-analyses.

Story 8. "A buried lake on Mars excited and baffled scientists"

The European Space Agency's Mars Express orbiter spotted what appears to be a lake of liquid water beneath ice near the Red Planet's south pole. Scientists are puzzled that NASA's Mars Reconnaissance Orbiter hasn't detected the lake, and they wonder how the water could stay liquid under 1.5 kilometers of ice when the temperature at that depth should be about –68° Celsius. One scientist speculates that the polar ice cap could be porous enough to keep the liquid water from freezing and to interfere with measurements from the NASA orbiter. If the lake does exist, any life that arose on early Mars might still hang on there.

Story 9. "Paralysis became less permanent with electricity"

Six paralyzed people were able to walk or take steps years after their injuries thanks to intensive rehabilitation and electric stimulation of their spinal cords, three small studies showed. Scientists are still trying to figure out why the stimulation works. It could be that the electrical stimulation acts like a hearing aid to boost signals between the spinal cord and the brain. It's also possible that the electric stimulation helps rebuild weakened neural connections.

Story 10. "Human smarts got a surprisingly early start"

A number of archaeological finds have pushed the roots of innovative behavior closer to the origin of the human genus, *Homo*, showing just how clever and adaptable our ancient relatives were. Among the findings: Hominids in East Africa created and traded new types of stone tools in the face of frequent climate swings 320,000 years ago. Humans in South Africa were making art 73,000 years ago, and a painted figure in Southeast Asia dates to 40,000 years ago. Neandertals left rock art in Spanish caves 64,800 years ago. And humanlike populations may have reached central China by 2.1 million years ago.

4. What questions do you still have after reading the article? What new questions do you have?

5. What research project might you propose to address one of the questions that you still have?

6. Log in to your *Science News* in High Schools account and use the Search page to find an older article on the same topic. What is the article title and when was it published? Name one fact that was previously known (from the old article) and one new or changed fact that the new article provides?

Possible student responses:

New article: "Claim of first gene-edited babies sounded alarms"
Old article: "Most Americans think it's OK to tweak a baby's genes to prevent disease," published July 26, 2018
Old fact: 72 percent of Americans surveyed favored changing an unborn baby's genetic makeup to treat a disease present at birth.

New/changed fact: There are widespread concerns about the health, ethical and social implications of newly born gene-edited babies.

New article: "Crime solvers embraced genetic genealogy"
Old article: "What genetic tests from 23andMe, Veritas and Genos really told me about my health," published May 22, 2018
Old fact: Personal genetic testing can provide interesting information about your family history but generally limited information about your health.
New/changed fact: Personal genetic testing is helping law enforcement officials track down criminals.

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Article-Based Observation: Q

Directions: Before reading the article assigned by your teacher, answer questions No. 1 and 2. Read your article silently and then answer questions No. 3 through 6. Be prepared to share your answers with the class.

2018 Year in Review: Top 10

1. "Half a degree stole the climate spotlight"
Readability score: 10.8
2. "Claim of first gene-edited babies sounded alarms"
Readability score: 10.2
3. "Crime solvers embraced genetic genealogy"
Readability score: 11.0
4. "Neutrino discovery ushered in a new era of astronomy"
Readability score: 12.8
5. "Crater renewed debate over an ancient climate mystery"
Readability score: 11.1
6. "We nudged closer to the Mosquito Terminator"
Readability score: 11.8
7. "Researchers sent mixed messages about drinking"
Readability score: 10.5
8. "A buried lake on Mars excited and baffled scientists"
Readability score: 9.0
9. "Paralysis became less permanent with electricity"
Readability score: 11.2
10. "Human smarts got a surprisingly early start"
Readability score: 13.6

1. Read the headline of the article. What background information do you already know about the topic based on the headline?

2. Given the headline, what do you want or expect to learn when you read the article?

3. Summarize what you learned from the article in 100 words or less.

4. What questions do you still have after reading the article? What new questions do you have?

5. What research project might you propose to address one of the questions that you still have?

6. Log in to your *Science News* in High Schools account and use the Search page to find an older article on the same topic. What is the article title and when was it published? Name one fact that was previously known (from the old article) and one new or changed fact that the new article provides?

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Cross-Curricular Connections: Q&A

Directions: Ask students to define key vocabulary to gain some scientific background knowledge and to better understand the concepts covered in *SN*'s Top 10 science stories. Once students answer the questions listed below, they can work in groups to identify other terms and concepts that need further explanation, define those terms and present the findings to the class in a creative way — such as a poster, infographic, commercial, skit or story.

Environmental Science

Story 1. "Half a degree stole the climate spotlight"

What are greenhouse gases?

Greenhouse gases are gases that contribute to the greenhouse gas effect by absorbing heat that would otherwise be transported back into space. Carbon dioxide (CO_2), methane (CH_4) and water vapor are examples of greenhouse gases.

What is carbon capture?

Carbon capture is the transfer of carbon dioxide emissions from human sources such as power plants to long-term storage somewhere else. Proposed methods of CO_2 capture and storage include growing large quantities of extra plants, injecting CO_2 into the ground or storing CO_2 at the bottom of the ocean.

Biological Sciences

Story 2. "Claim of first gene-edited babies sounded alarms"

What is CRISPR/Cas9?

CRISPR/Cas9 is a gene-editing tool that is used to alter the DNA of cells or organisms. CRISPR is an abbreviation — pronounced crisper — for the term "clustered regularly interspaced short palindromic repeats." CRISPRs are pieces of RNA, an information-carrying molecule. They are copied from the genetic material of viruses that infect bacteria. When a bacterium encounters a virus that it was previously exposed to, it produces an RNA copy of the CRISPR that contains that virus's genetic information. The RNA then guides an enzyme, called Cas9, to cut up the virus and make it harmless. Scientists are now building their own versions of CRISPR RNAs. These lab-made RNAs guide the enzyme to cut specific genes in other organisms. Scientists use them, like genetic scissors, to edit — or alter — specific genes so that the scientists can study how the genes work, repair damage to broken genes, insert new genes or disable harmful ones.

What are "designer babies"?

Designer baby is the nickname used for a child whose DNA has been altered to remove unfavorable traits (such as disease-causing versions of genes) and/or add favorable traits (such as gene versions for higher intelligence or preferred physical characteristics). Genetically altering human embryos poses ethical concerns.

Story 3. "Crime solvers embraced genetic genealogy"

What is DNA fingerprinting?

DNA fingerprinting is the use of DNA to find out the identity of a person or to discover the relationship between different organisms. In DNA fingerprinting, scientists study the patterns of DNA molecules in specific genes and compare them. In particular, there are several regions called short tandem repeat (STR) loci, also called microsatellites or variable number of tandem repeats (VNTR). At each STR locus, a short DNA sequence — typically four or five nucleotides long — is repeated several times in a row. Different people have different numbers of repeats at each STR locus. Two unrelated people might have the same number of repeats at one STR locus, but the odds of having the same numbers of repeats at many different STR loci are astronomically low, similar to the odds of having the same fingerprint.

Story 6. "We nudged closer to the Mosquito Terminator"

What is a gene drive?

A gene drive is a technique for introducing new bits of DNA into a gene to change the gene's function. Unlike other such genetic engineering techniques, gene drives are self-propagating. That means they make more of themselves, becoming part of every unaltered target gene they encounter. As a result, gene drives get passed on to more than 50 percent of an altered animal's offspring, "driving" themselves quickly into populations.

What is a disease vector?

A vector is an organism that can spread disease, such as by transmitting a germ from one host to another. Many disease vectors are insects. For example, mosquitoes can spread malaria-causing protozoa, the Zika virus, and other pathogens from one person to another.

Story 7. "Researchers sent mixed messages about drinking"

What is a meta-analysis?

A meta-analysis is a technique in which scientists pool a large number of previous scientific studies on a single topic and try to identify patterns among them. Meta-analyses allow scientists to look at many studies at once and so work with a large amount of data. But the studies also can be biased. They rely only on data that has already been published (and so might ignore studies that weren't published because the researchers didn't find anything). In addition, most scientists don't do studies in exactly the same way. The tiny differences between studies could affect the conclusions. Finally, with so many papers pooled together, a meta-analysis might pull out effects that aren't really there at all. But if done correctly, these tests can serve a purpose.

What is the liver?

The liver is an organ in the body of animals with backbones that performs a number of important functions. It can store fat and sugar as energy, break down harmful substances for excretion by the body, and secrete bile — a greenish fluid released into the gut, where it helps digest fats and neutralize acids.

Story 9. "Paralysis became less permanent with electricity"

What is a spinal cord injury?

A spinal injury is damage to the spinal cord, a cylindrical bundle of nerve fibers and associated tissue that is enclosed in the spine and connects nearly all parts of the body to the brain. Spinal injuries may result from automobile or motorcycle accidents, sports accidents, serious falls, bullet wounds or other types of accidents. An injury to the lower part of the spinal cord is likely to affect only the lowermost parts of the body, such as the legs (paraplegia). An injury higher up on the spine can affect both the legs and arms (quadriplegia). An injury even higher can affect most bodily functions, even breathing.

Story 10. "Human smarts got a surprisingly early start"

What are hominids?

Hominids are primates within the animal family that includes humans and their ancient upright-walking relatives. Hominids split off from other apes in Africa, most recently from a shared ancestor with chimpanzees. The genus Homo *includes modern humans,* Homo sapiens*, as well as a number of earlier species and subspecies. All hominids except humans are known only from fossils.*

Physics and Astronomy

Story 4. "Neutrino discovery ushered in a new era of astronomy"

What are neutrinos?

Neutrinos are nearly massless subatomic particles. Neutrinos rarely react with normal matter — they do not experience electromagnetic interactions with other matter (they have no electric charge), strong nuclear force interactions with other matter or much gravitational interaction with other matter.

What are blazars?

Blazars are bright and distant active galaxies that shoot powerful jets of radiation from their centers directly toward Earth.

Story 5. "Crater renewed debate over an ancient climate mystery"

What is a meteorite?

A meteorite is a lump of rock or metal from space that passes through Earth's atmosphere and collides with the ground. Meteorites can be made of different materials including iron, nickel and silicates.

What is a comet?

A comet is a celestial object consisting of a nucleus of ice and dust. Scientists think that most comets originate in the Oort cloud, a cloud of dust and debris thought to exist at the outer edge of the solar system. Comets that get close enough to the sun begin to melt, creating a visible tail that is pushed away from the sun by the solar wind.

Story 8. "A buried lake on Mars excited and baffled scientists"

What is freezing point depression?

Freezing point depression is the lowering of the temperature at which a solution freezes. When a solute dissolves in a solvent, the freezing point of the solution is lower than the freezing point of the pure solvent. The extent to which the freezing point of a solution decreases depends on the number of dissolved solute particles.

What is an insulator?

An insulator is a material that does not readily allow heat, electricity, light or sound to pass through it. Air, glass, rubber and wood are examples of common insulators.

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Cross-Curricular Connections: Q

Directions: Define key vocabulary to gain scientific background knowledge in order to better understand the concepts covered in *SN*'s Top 10 science stories.

Environmental Science

Story 1. "Half a degree stole the climate spotlight"

What are greenhouse gases?

What is carbon capture?

Biological Sciences

Story 2. "Claim of first gene-edited babies sounded alarms"

What is CRISPR/Cas9?

What are "designer babies"?

Story 3. "Crime solvers embraced genetic genealogy"

What is DNA fingerprinting?

Story 6. "We nudged closer to the Mosquito Terminator"

What is a gene drive?

What is a disease vector?

Story 7. "Researchers sent mixed messages about drinking"

What is a meta-analysis?

What is the liver?

Story 9. "Paralysis became less permanent with electricity"

What is a spinal cord injury?

Story 10. "Human smarts got a surprisingly early start"

What are hominids?

Physics and Astronomy

Story 4. "Neutrino discovery ushered in a new era of astronomy"

What are neutrinos?

What are blazars?

Story 5. "Crater renewed debate over an ancient climate mystery"

What is a meteorite?

What is a comet?

Story 8. "A buried lake on Mars excited and baffled scientists"

What is freezing point depression?

What is an insulator?

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Activity Guide for Teachers: Asking for Directions on Mars

Purpose: Students will learn how to use an interactive online map of Mars — including working with coordinate systems and layers — and will identify features and make generalizations about Martian geography.

Procedural overview: After a review of latitude and longitude, students will explore NASA's Mars Map, first through a tutorial and then on their own. Students will identify specific sites and will use the map's interactive tools to learn more about the sites and locate nearby geographic features. Finally, students will make geographic generalizations about specific regions. Sites on Mars come from "A buried lake on Mars excited and baffled scientists," "A year of launches and farewells in space" and even from the fictional film *The Martian*.

Approximate class time: One class period.

Supplies:

- Activity Guide for Students: Asking for Directions on Mars
- Access to NASA's Mars Map
- Earth globe (for comparison with Mars and to help students understand latitude and longitude lines). Available from Amazon or other websites for $25.
- OPTIONAL: Sky & Telescope 12" Mars globe (to help visualize Mars as a sphere). Available from Shop at Sky, Amazon or other websites for about $100.

Directions for teachers:

Review the concepts of latitude and longitude with your students as necessary. The coordinate system works the same on Mars as on Earth. Lines of latitude run parallel to the equator and measure north-south position between the poles. Lines of longitude run through the north and south poles and measure east-west positions relative to the prime meridian. Demonstrate these concepts using the Earth globe (and the Mars globe if you have it).

Here are some general points to highlight:

- If you are looking at the planet's surface with north upward and south downward, east is to the right and west is to the left. Both Earth and Mars rotate such that the sun appears to rise in the east and set in the west.
- Latitude is how many degrees north or south of the equator a location is; 90° N is the North Pole, and 90° S is the South Pole.
- Longitude is how many degrees east or west a location is relative to an arbitrarily defined prime meridian. The point 0°, 0° is where the prime meridian intersects the equator. 0°, 180° is on the exact opposite side of the planet, and is the point of intersection between the antimeridian and the equator. 270° E is the same as 90° W and so on.

Now it's time for Mars. NASA's Mars Map automatically begins with a nice tour that shows how to use the program. Make sure you get comfortable using the interactive yourself before shepherding your students through the site.

Directions for students:

Take the tutorial

Go to NASA's Mars Map, take the tutorial and answer the following questions.

1. Briefly explain what each of the following buttons looks like and the actions it allows you to take.

    Menu

    Search

    Tools

    Share

    Layers

    Explorer

    Projections

    Fly To

2. What kind of information can you add to the map by applying each item listed below? How does the interactive map change when you add the item?

    Bookmark

    Nomenclature

    Product

3. Where is map information such as scale and latitude/longitude coordinates displayed?

Begin to explore the map

Now explore some of the features mentioned in the tutorial by answering the following questions.

4. As you move your mouse across the map in Global Map view, what do you notice about the latitude and longitude coordinates? Which is listed first? How are they different from Earth's coordinates? What does a negative latitude mean? What does a negative longitude mean? Why do you think that the interactive map uses the negative values?

5. What are the coordinates for the point where Mars' equator intersects Mars' prime meridian? What about the point where the equator intersects the antimeridian? Do these points have the same or different coordinates on Earth? What is the latitude of the prime meridian?

6. Go to the Layers panel and select "Static." You can click the "Toggle Visibility" button (looks like an eye) for layers such as Nomenclature and Graticule. Using the Fly To button, type in only the longitude of the prime meridian. The name of the feature that defines the prime meridian's location on Mars will appear below as you type. What is its name? Click on the feature's name to find it on the map. Click on the Explorer button, find the name of the feature and click on it. The feature should be flagged on the map. Based on the map topography, what type of feature is it? You can check your answer by searching for the feature using the search panel.

7. In the same view (the scale should measure about 50 kilometers), click on the Explorer button. Identify a landing site within your view, name it and give its approximate coordinates. What other geographic features are within the view? Name one geographic feature and give its approximate diameter in miles (change the units of the scale, if necessary).

8. Using the Search panel, locate and "fly to" two other successful landing sites. Use the map topography and the Explorer button (when zoomed so the scale is approximately 50 km) to describe the geographic features near the site. Use the map tools available to give two other interesting facts about the site.

9. Using the Search panel, locate and "fly to" the Martian Path (from the fictional film *The Martian*). Describe the approximate size of the area shown. Use the map topography and the Explorer button to describe the geographic features in the area. On the Layers panel with "Static" selected, you can click the "Toggle Visibility" button (looks like an eye) to see more information. Imagine that you are in a rover near the Martian Path. Based on the information you have gathered, where would you travel and what would you expect to see during your journey and upon your arrival?

10. Finally, using the Fly To button, locate the site of the possible underground lake reported in the *Science News* article "A buried lake on Mars excited and baffled scientists," at -81, -167 (or 81° S, 167° W). What do you notice about the limitations of Global Map view in this region? Is there a better map projection that you can use to view the area? Use the Explorer tool to name any geographic features nearby.

Make geographic generalizations

Now that you're familiar with the map and some geographic features, you can form some generalizations.

11. Use the Projections button to toggle through different map projections. Make sure you have turned on Graticule in the Static Layer panel, so you can see the lines of latitude and longitude. Observe the geography in the regions listed below. Describe any patterns or predominate features that you see. Please note: In the 3D Globe view, you may want to adjust the "Terrain Exaggeration" so you are better able to distinguish geographic features.

    North Pole region:

    South Pole region:

Northwest hemisphere:

Northeast hemisphere:

Southwest hemisphere:

Southeast hemisphere:

12. If you could choose a location for a future lander or rover mission to Mars, where would you choose? What factors would you consider?

13. Would you sign up for the first human landing on Mars? Why or why not?

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Activity Guide for Students: Asking for Directions on Mars

Purpose: To learn how to use an interactive online map of Mars — including working with coordinate systems and layers — and will identify features and make generalizations about Martian geography.

Procedural overview: After a review of latitude and longitude, you will explore NASA's Mars Map, first through a tutorial and then on your own. You will identify specific sites and will use the map's interactive tools to learn more about the sites and locate nearby geographic features. Finally, you will make geographic generalizations about specific regions. Sites on Mars come from "A buried lake on Mars excited and baffled scientists," "A year of launches and farewells in space" and even from the fictional film *The Martian*.

Directions for students:

Take the tutorial

Go to NASA's Mars Map, take the tutorial and answer the following questions.

1. Briefly explain what each of the following buttons looks like and the actions it allows you to take.

    Menu

    Search

    Tools

    Share

    Layers

    Explorer

    Projections

    Fly To

2. What kind of information can you add to the map by applying each item listed below? How does the interactive map change when you add the item?

    Bookmark

    Nomenclature

Product

3. Where is map information such as scale and latitude/longitude coordinates displayed?

Begin to explore the map

Now explore some of the features mentioned in the tutorial by answering the following questions.

4. As you move your mouse across the map in Global Map view, what do you notice about the latitude and longitude coordinates? Which is listed first? How are they different from Earth's coordinates? What does a negative latitude mean? What does a negative longitude mean? Why do you think that the interactive map uses the negative values?

5. What are the coordinates for the point where Mars' equator intersects Mars' prime meridian? What about the point where the equator intersects the antimeridian? Do these points have the same or different coordinates on Earth? What is the latitude of the prime meridian?

6. Go to the Layers panel and select "Static." You can click the "Toggle Visibility" button (looks like an eye) for layers such as Nomenclature and Graticule. Using the Fly To button, type in only the longitude of the prime meridian. The name of the feature that defines the prime meridian's location on Mars will appear below as you type. What is its name? Click on the feature's name to find it on the map. Click on the Explorer button, find the name of the feature and click on it. The feature should be flagged on the map. Based on the map topography, what type of feature is it? You can check your answer by searching for the feature using the search panel.

7. In the same view (the scale should measure about 50 kilometers), click on the Explorer button. Identify a landing site within your view, name it and give its approximate coordinates. What other geographic features are within the view? Name one geographic feature and give its approximate diameter in miles (change the units of the scale, if necessary).

8. Using the Search panel, locate and "fly to" two other successful landing sites. Use the map topography and the Explorer button (when zoomed so the scale is approximately 50 km) to describe the geographic features near the site. Use the map tools available to give two other interesting facts about the site.

9. Using the Search panel, locate and "fly to" the Martian Path (from the fictional film *The Martian*). Describe the approximate size of the area shown. Use the map topography and the Explorer button to describe the geographic features in the area. On the Layers panel with "Static" selected, you can click the "Toggle Visibility" button (looks like an eye) to see more information. Imagine that you are in a rover near the Martian Path. Based on the information you have gathered, where would you travel and what would you expect to see during your journey and upon your arrival?

10. Finally, using the Fly To button, locate the site of the possible underground lake reported in the *Science News* article "A buried lake on Mars excited and baffled scientists," at -81, -167 (or 81° S, 167° W). What do you notice about the limitations of Global Map view in this region? Is there a better map projection that you can use to view the area? Use the Explorer tool to name any geographic features nearby.

Make geographic generalizations

Now that you're familiar with the map and some geographic features, you can form some generalizations.

11. Use the Projections button to toggle through different map projections. Make sure you have turned on Graticule in the Static Layer panel, so you can see the lines of latitude and longitude. Observe the geography in the regions listed below. Describe any patterns or predominate features that you see. Please note: In the 3D Globe view, you may want to adjust the "Terrain Exaggeration" so you are better able to distinguish geographic features.

    North Pole region:

    South Pole region:

    Northwest hemisphere:

    Northeast hemisphere:

    Southwest hemisphere:

    Southeast hemisphere:

12. If you could choose a location for a future lander or rover mission to Mars, where would you choose? What factors would you consider?

13. Would you sign up for the first human landing on Mars? Why or why not?

SN EDUCATOR GUIDE

December 22, 2018 & January 5, 2019

2018 Year in Review

Other Related Articles

***Science News for Students*:**

Related to *Science News* Story 1:

"Half a degree can make a world of difference"
Readability score: 8.2

"Climate change chronicles"

Related to *Science News* Story 2:

"Scientist reports first gene editing of humans"
Readability score: 8.2

Related to *Science News* Story 4:

"Scientists traced an incoming neutrino back to its galactic birthplace"
Readability score: 8.3

Related to *Science News* Story 5:

"An ancient cold snap causes heated debate"
Readability score: 7.6

Related to *Science News* Story 6:

"Gene editing wiped out a population of mosquitoes in lab tests"
Readability score: 7.8

Related to *Science News* Story 8:

"Mars appears to have a lake of liquid water"
Readability score: 7.3

"Finding living Martians just got a bit more believable"
Readability score: 8.4

Related to *Science News* Story 9:

"Zaps to spinal cord help paralyzed people walk"
Readability score: 8.0

Related to *Science News* Story 10:

"Ancient jaw suggests humans left Africa earlier than thought"
Readability score: 8.7

SOCIETY FOR SCIENCE & THE PUBLIC